Appendix B-2e

Geophysical Prove-Out
Documentation

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Final
Geophysical Prove-Out
Work Plan

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TETRA TECH EC, INC.

August 4, 2005
FWHN-FTMC-05-0041

Ms. Wanda Hampton
Contracting Officer
US Army Engineering and Support Center, Huntsville
P.O. Box 1600
Huntsville, AL 35807

Subject: Revised Final Geophysical Prove-out Work Plan, Eastern Bypass Removal Action (Construction Debris) August, 2005. Task Order 0010, Ordnance and Explosive Response at Fort McClellan, Alabama, Contract Number DACA87-99-D-0010

Dear Ms. Hampton:

In accordance with the Statement of Work for Task Order 0010, Tetra Tech EC is submitting the Revised Final Geophysical Prove-out Work Plan for the Eastern Bypass Removal Action (Construction Debris), August 2005, with revisions per your conversation with Mr. Mike Anderson, on August 1,2005.

If you require additional information, please contact Mike Anderson, Geophysicist, or me at (256) 830-4100. Also, please notify Mr. Mike Anderson and myself upon approval of this document.

Sincerely,

AB Holcomb

Arthur B. Holcomb, P.E., CIH
Project Manager

Enclosures, as stated

CF: Mr. Daniel Copeland, US Army Engineering and Support Center, Huntsville
Ms. Debbie Edwards, US Army Engineering and Support Center, Huntsville

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TETRA TECH EC, INC.

FINAL
Geophysical Prove-Out Work Plan

for

Ordnance and Explosives (OE) Removal Action
Eastern Bypass
Fort McClellan, Alabama

Task Order 0010

Contract Number:
DACA87-99-D-0010

Prepared For:
U.S. Army Engineering and Support Center
Huntsville, Alabama

Prepared By:
Tetra Tech EC INC.

August 2005

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APPENDIX B - FIGURES

LIST OF ACRONYMS

CEHNC	United States Army Engineering and Support Center, Huntsville
EM	Electromagnetic
ft	Feet
DGPS	Differential Global Positioning System
DID	Data Item Description
GPO	Geophysical Prove-Out
mV	Millivolts
OE	Ordnance and Explosives
PCMCIA	P.C. Memory Card International Association
PLS	Professional land surveyor
QA	Quality Assurance
QC	Quality Control
RTS	Robotic Total Station
TDEM	Time Domain Electromagnetic
UXO	Unexploded Ordnance

1.0 INTRODUCTION

The United States Army Engineering and Support Center Huntsville (CEHNC) has contracted Tetra Tech EC Inc. (TtEC), under Contract DACA87-99-D-0010, to perform a Geophysical Prove-Out (GPO) at Fort McClellan located in Anniston, Alabama. The task will be performed in July of 2005, in support of the Eastern Bypass Removal Action.

1.0.1 TtEC constructed the existing test grid in August of 2002. It has served as a testing area for over 3 years. In addition to performing Geophysical Prove-outs, TtEC has used the test area following changes in equipment, changes in significant field personnel and/or operational procedures. The following document will discuss the construction of the existing test grid and summarize the actions to be performed during the upcoming GPO.

2.0 OBJECTIVE

The objective of the GPO is to demonstrate and document the performance of the data acquisition methodology and spatial sampling protocols, sensor(s) and positioning equipment, data analysis and management systems, data transfer procedures, and the geophysical Quality Control (QC) system. The following components of the geophysical system will be evaluated during the GPO field program to ensure the program objectives will be met:

- Spatial sample density (i.e., line and station spacing)
- Navigation and positioning methodologies
- Sensor and positioning system platform (stability, noise characteristics and ergonomics)
- Data processing, analysis and interpretation, management and transfer system
- Quality Assurance (QA) Control, documentation protocol for data acquisition, processing and analysis and data management and transfer

2.0.1 The GPO test grid was designed and placed in a location where it can be maintained for ongoing usage. TtEC has continually utilized the area to validate the geophysical systems throughout the duration of a given project. This process will be maintained during the present Eastern Bypass Removal Action.

3.0 TEST GRID LOCATION AND DESIGN

3.1 LOCATION

The GPO area is located near the scrap yard off Bains Gap Road (Figure B-1). It is an excellent representation of the environment to be encountered during geophysical operations during the removal action. The principle area of concern is open, however some areas are adjacent to the tree-line.

3.1.1 The trees, some with continuous foliage, are similar to those to be found in the Area of concern. A smaller grid (test grid #2 in Figure B-1) is positioned in a heavily wooded area. This grid is designed for internal testing of new technology. It will not be used for this GPO, however CEHNC is welcome to utilize this grid at any time.

3.1.2 A fence is located approximately 30 feet from the northern side of the GPO test plot, as seen in the picture to the left. This will allow our geophysicist to determine if signal interference from the cultural features may present a problem.

3.1.3 A background geophysical survey (Figure B-2) of the test plot was performed prior to seeding the existing items. Qualified UXO technicians removed the detected anomalies from the subsurface.

3.2 DESIGN

TtEC began construction of a 165ft x 70ft test grid at the site in August of 2002 to meet the requirements of Data Item Description (DID) OE-005-05A.01. The grid design remains in accordance with DID MR-005-05A. The Grid corners were predetermined and surveyed using a high resolution Leica Total Station. The control points were calculated from pre-existing monuments, which had been established through a Differential Global Positioning System (DGPS) operated by a professional land surveyor (PLS). A PLS was used to determine the position of all corner points and seeded items. Measurements of the seeded items were performed in accordance with DID MR-005-05A. The points were calculated to an accuracy of no more then 3cm in the horizontal plane and 5cm in the vertical plane. Coordinates of the test grid corners are presented in Table A-2.

3.2.1 Anomaly avoidance techniques were used prior to placing wooden stakes at each corner and mid point of the grid. A metallic nail was driven into the ground at the grid corners and mid points to facilitate relocation of the corner points for future use. Anomaly avoidance techniques will be used when applicable where any objects are to be place in the ground.

3.2.2 The items presently located in the grid are specified in Table A-1. These items were provided by CEHNC and were buried by TtEC. All of the seeded items are inert Unexploded Ordnance (UXO) painted blue and tagged with a non-biodegradable label identifying the item as inert and providing a contact reference. The following procedures were used in seeding the items for the existing test grid and will also be used to seed the additional items:

1. Inert seeded items were labeled and photographed before burial.
2. Holes were dug with a shovel and backhoe.
3. The seeded item was placed in the hole and the depth measured to the top of the item using a bar placed across the hole at ground level for reference. For larger items (e.g., 2.36 inch rocket), the center point and both ends of the item were measured (all additional 27 items will be measured at the nose, tail and center point).

4. The items were buried with one end of a bar on the item. The dirt was then replaced in the hole; the bar was replaced with the pin flag noting the item number.
5. The location of the item was then determined using a high-resolution positioning system (Constellation) based on the center of mass of each item while it resided in the excavation. The location and depth of each item was recorded in an Excel Table.

4.0 EQUIPMENT

Based on our previous experience at numerous UXO sites including Ft. McClellan, the EM61 MK2 TDEM instrument exhibits the greatest potential to meet the program objectives. TtEC will evaluate the following equipment in the GPO test grid.

4.1 EM61 MK2

In general, the EM61 MK2 utilizes two coaxial receiver coils to measure the residual magnetic field generated by conductive and/or magnetic materials. The EM61 MK2's employed by TtEC are designed to measure the residual magnetic field at a time when the response from conductive and/or magnetic objects is maximized, compared to the response from most earth materials. The use of two receiver coils also makes it possible to differentiate, in a simplistic fashion, shallow versus deep objects. An additional benefit of the specific design of the EM61 MK2 system is that it permits a more focused observation of the subsurface in areas of cultural interference as well as areas characterized by a high spatial density of subsurface objects. This is due to the mechanical design and operational parameters of the instrument, as well as the inherent nature of active electro-magnetic (EM) fields, which diminish in magnitude at a much higher rate than other sensor technologies such as magnetometry.

4.1.1 A modified version of the standard EM61 the EM61 MK2, utilizes multiple time-gates centered at 216, 366, 660, and 1,266 μs. The signal intensity for a given ferrous target recorded by the earlier time-gates is generally a factor of 2 to 4 times that recorded by the standard (660μs) EM61 MK2 time-gate for the top and bottom Coil. This feature facilitates a more efficient and repeatable interpretation of smaller targets such as 37mm projectiles.

4.2 VALLON

The Vallon is a handheld mine and UXO detector. This unit will be used for target reacquisition, and may be used in small areas where the EM61 MK2 system is unable to acquire data due to terrain or vegetation. The Vallon utilizes a 30-cm or 60 cm search coil and has a search depth of up to two (2) meters.

4.3 DIFFERENTIALLY CORRECTED GLOBAL POSITIONING

The Leica Base Station (or "Reference") is setup on a benchmark with known coordinates. Then, as the receiver determines its location from the satellites, it compares these "calculated" positions to the know coordinates to determine the error in the calculated position. These errors can be recorded, and used to "correct" data collected by various GPS receivers in the field ("Rovers"), as long as the data from the Rovers is collected simultaneously with the reference data.

The use of a reference to provide error corrections forms the basis of "Differential GPS" and has dramatically improved the accuracy of GPS systems from several meters to less than a few centimeters. Corrections are typically applied to the field data well after the data is collected utilizing "post-processing" software such as "GrafNav". Typical "post-processing" applications include: 1) Surveying the locations of isolated points such as stakes, obstacles or ordnance items, which are typically recorded in static (non-moving) mode or 2) Surveying a path, or boundary (fences, lakes, buildings, etc) recording data in a kinematic (moving) mode. However, error corrections can also be broadcast (via radio modem) to rover units (also equipped with radio modems) to correct data in "real-time". This is particularly useful for "stakeout" procedures, whereby previously determined coordinates are loaded into the Rover units, then physically "re-acquired" and staked for various applications (defining grid corners, target re-acquisition, … etc).

4.4 ROBOTIC TOTAL STATION (RTS)

The Leica 1200 series motorized Robotic Total Station (RTS) utilizes line-of-site to accurately determine a position in space. The RTS continuously records the position by tracking the location of the 360° prism located on top of a survey rod.

5.0 PROCEDURES

5.1 INSTRUMENT CONFIGURATIONS

Due to potential tree coverage two instrument configurations, will be tested at the GPO.

5.1.1 The specific system configuration to be performed at the GPO grid include:

GPO Instrument Configurations

Instrument	Coils	Time Gates	Positioning	Line Spacing (ft.)
EM61 MK2	1m by 1m	216 µs, 366 µs, 660 µs	DGPS	~2.5
EM61 MK2	1m by 1m	216 µs, 366 µs, 660 µs	RTS	~2.5

5.1.2 Geophysical data will be collected over 100% of the test area with the EM61 MK2 logging at 12-15 times per second and a line spacing of ~ 2.5 feet. The EM61 MK2 instrument height will be set at 15 inches above ground. The instrument height will be measured prior to each data acquisition session.

5.2 MAN-PORTABLE SURVEY METHOD

The man-portable acquisition method will be applied during the GPO. In the man-portable configuration, two (2) operators will be used to collect the data. One (1) person transports the EM61 MK2 coils and positioning system detector while the other person, walking approximately seven to eight feet behind, carries the EM61 MK2 electronics and the positioning system logging device. The positioning system detector will be centered above the EM61 MK2 coils for both instrument configurations

5.3 Data Processing and Management

Data will be stored on PCMCIA cards during data acquisition. After acquisition over the test grid is complete, data will be transferred from the PCMCIA cards to the site PC for processing. A TtEC geophysicist will perform preliminary geophysical and navigation data processing and QC checks in the field. The final analysis and interpretation of the data will be performed at a centralized processing center located at the TtEC Huntsville, Alabama or at the on-site TtEC field office. Processing, QC, analysis and interpretation of the data will be performed with internally developed software that has been specifically produced to integrate and interpret digital geophysical data acquired with the above-mentioned positioning systems. Geosoft Oasis Montaj Mapping software will also be used to graphically display data.

5.3.1 Several steps will be performed to process the geophysical data prior to analysis. All data will be processed and transformed into the requested coordinate system (State plane zone Alabama North, NAD83). EM61 MK2instrument bias will be removed, signal drift corrected and minor instrument positioning (lag) corrections applied.

5.3.2 The data will be interpreted using one of two independent modes of target prediction (profile data and color-coded image data) to provide x, y and z location information for each target. Data transfer will be tested during the GPO, including the transfer of raw EM and positioning data.

5.3.3 A dig sheet will be generated on Microsoft Excel and shall include tables as well as graphical representations of the test grid. The dig sheet will be given to the reacquire team as described in section 6.1.

6.0 RESULTS AND THE GPO LETTER REPORT

The results of the GPO will be submitted in the GPO letter report in tabular and graphical form. The TtEC seeded targets will be indicated with a cross (+). The interpreted target locations will be labeled with a green circle (●). The GPO Letter report will include, at a minimum, the following:

- As-built drawing of the GPO plot;
- Pictures of the seed items;
- Color maps of the geophysical data;
- Summary of the GPO results;
- Proposed geophysical equipment, techniques, and methodologies; and
- Sufficient supporting information to justify the project team's recommendations, including manufacturer specifications for all recommended geophysical equipment, a

definition of the expected target anomalies based upon the Archives Search Report, Site Inspection Report, Remedial Investigation/Feasibility Study or Engineering Evaluation/Cost Analysis results, or any other pertinent data/information used in decision making.

A CD shall be delivered with the letter report containing the following files:

- The GPO Letter Report (Microsoft Word format);
- All raw and processed geophysical data. All data, except raw instrument data, shall be provided in column delineated ASCII files in the format x, y, z, v1, v2, etc., where x and y are UTM Grid Plane Coordinates in Easting (meters) and Northing (meters) directions, z (elevation) is an optional field in meters, and v1, v2, v3, etc., are the instrument readings. The last data field should be a time stamp. Each data field shall be separated by a comma or tab.
- Geophysical maps in their native format (Surfur®, Geosoft Oasis montaj™, Intergraph, or ESRI ArcView format) and/or as raster bit-map images such as BMP, JPEG, TIFF or GIF;
- Seed item location spreadsheet (Microsoft Excel format);
- Spreadsheet (Microsoft Excel format) of contractor picks for each sensor type, including reacquisition; and
- Spreadsheet (Microsoft Excel format) of all control points, survey points and benchmarks established or used during the Location Surveying task.
- The contractor may not proceed with production geophysical mapping until the Government approves the GPO results as provided in the GPO Letter Report.
- The GPO Letter Report and Contracting Officer Approval Letter shall be included in future geophysical reports and work plans associated with the survey area.
-

6.0.1 Target selection criteria will include anomaly size, shape, amplitude and background noise. In some cases, if background noise levels are sufficiently low, anomalies with lower amplitudes will be selected if size and shape characteristics indicated potential buried metal.

6.1 Target Reacquisition

Target reacquisition accuracy will be evaluated using the TtEC seed items. A UXO Technician will be given a digsheet and will reacquire the anomalies listed on the digsheet using the previously mentioned positioning systems. The Technician will then use a Vallon to pinpoint the target location. The position of the actual item will be compared to the position determined by the technician. We will meet the requirement as per DID OE-005-005A.01, which states that 95% of the reacquired items shall fall within 1 meter of the target location.

6.2 QUALITY CONTROL

Instrument and functional checks will be performed at the beginning and end of every data acquisition session. Independent QC tests to be performed include static tests, line tests and positioning (cloverleaf) tests. As mentioned in the introduction, the GPO test grid will be used to validate operation procedures based on any changes in equipment, personnel or objectives. These tests will be documented and delivered to CEHNC.

6.2.1 Equipment Warm-up

The geophysical equipment will be turned on and allowed to run for a period of time sufficient to allow the system to reach operating temperature.

6.2.2 Distance Between Sensors

The distance between the top and bottom sensors as well as the height above ground will be measured and recorded.

6.2.3 Personnel Test

All personnel involved in data collection during the removal action will be involved with data collection during the GPO to ensure that they are free of metallic objects and are able to collect geophysical data to the standards set by the project Geophysists (i.e., maintaining consistent line spacing).

6.2.4 Shake Test

All Cables and connections will be shook in a manner simulating walking in rough terrain. Any noise induced from this test will be recorded and the appropriate corrective action will be implemented.

6.2.5 Static Tests

The static test involves locating the instrument over a magnetically quiet area and recording data for a minimum of three (3) minutes, then placing a steel ball under the instrument and recording an additional three (3) minutes of data. The photograph at the right depicts the testing scenario.

6.2.6 Six Line Tests

The line test involves collecting data along an 80-foot line six times. The purpose of the line test is to determine noise due to system movement/motion as well as location error caused by temporal time lag or spatial correction due to waypoint placement. For the first two (2) line tests, data will be collected along the line in each direction at a normal pace with no object on the ground (Lines 1 and 2). A steel ball will then be placed near the middle of the line and data will be collected along the line in each direction at a slow pace and a fast pace. (Lines 3 and 4). Lines 5 and 6 shall be surveyed at a normal pace.

6.2.7 Positioning Tests

To test the positioning, the navigation unit will record data in a clover-leaf pattern around one (1) known points, with the operator crossing over the known point from three (3) different directions. The line path will then be plotted over the known point.

6.2.8 Repeat Lines

A minimum of 2% of the lines collected during the GPO will be recollected and analyzed for repeatability determination.

APPENDIX A

TABLES

TABLE A-1: GEOPHYSICAL PROVE-OUT ANOMALIES

X	Y	Target ID	Item	Depth(in)	Orientation
677699.94	1167164.58	a1	37mm	4.00	Horizontal
677708.37	1167173.14	a2	37mm	4.00	Vertical
677719.73	1167188.12	a3	81mm	34.00	Horizontal
677721.10	1167175.99	a4	2.36" rocket	26.00	Horizontal
677730.10	1167179.32	a5	rocket motor	12.00	Horizontal
677723.37	1167167.69	a6	37mm	16.00	Horizontal
677735.00	1167169.03	a7	60mm	12.00	Vertical
677735.62	1167156.66	a8	MKII HG	8.00	Vertical
677745.30	1167155.03	a9	2.36" rocket	6.00	Vertical
677743.41	1167136.92	a10	Anti Tank Mine	6.00	Horizontal
677726.67	1167132.67	a11	60mm	6.00	Vertical
677718.25	1167118.37	a12	MKII HG	4.00	Horizontal
677719.58	1167146.36	a13	37mm	0.00	Horizontal
677688.23	1167097.99	a14	3 "stokes	20.00	Horizontal
677704.27	1167108.58	a15	3 "stokes	32.00	Horizontal
677694.61	1167113.24	a16	75mm	30.00	Horizontal
677709.18	1167133.61	a17	60mm	25.00	45 degrees
677691.87	1167128.25	a18	75mm	12.00	Vertical
677681.35	1167118.85	a19	MKII HG	14.00	Horizontal
677673.49	1167132.86	a20	75mm	18.00	45 degrees
677666.45	1167141.88	a21	37mm	4.00	45 degrees
677680.90	1167152.03	a22	slap flare	4.00	45 degrees
677706.20	1167151.98	a23	105mm	45.00	45 degrees
677753.84	1167216.57	a24	37mm	4.00	Horizontal
677765.13	1167208.06	a25	37mm	4.00	Vertical
677771.70	1167196.19	a26	81mm	17.00	Horizontal
677771.95	1167190.79	a27	2.36" rocket	26.00	Horizontal
677781.41	1167187.60	a28	rocket motor	12.00	Horizontal
677794.28	1167178.14	a29	37mm	16.00	Horizontal
677775.16	1167162.11	a30	60mm	12.00	Vertical
677767.82	1167173.71	a31	MKII HG	8.00	Vertical
677763.33	1167167.94	a32	2.36" rocket	6.00	Vertical
677750.42	1167179.97	a33	60mm	6.00	Horizontal
677756.51	1167195.77	a34	60mm	6.00	Vertical
677740.94	1167197.48	a35	MKII HG	4.00	Horizontal
677741.04	1167180.67	a36	37mm	0.00	Horizontal
677728.58	1167178.52	a37	3 "stokes	20.00	Horizontal
677733.40	1167171.79	a38	3 "stokes	32.00	Horizontal
677743.27	1167161.79	a39	75mm	30.00	Horizontal
677758.76	1167148.27	a40	81mm	25.00	45 degrees
677697.46	1167163.21	a41	75mm	12.00	Vertical
677699.23	1167155.70	a42	MKII HG	0.00	Horizontal
677700.11	1167144.91	a43	75mm	18.00	45 degrees
677715.77	1167137.08	a44	37mm	4.00	45 degrees
677715.85	1167112.69	a45	slap flare	4.00	Vertical

Table A-1: Geophysical Prove-Out Anomalies (Continued)

X	Y	Target ID	Item	Depth (in)	Orientation
677706.94	1167104.36	a46	105mm	10.00	Vertical
677693.62	1167134.69	a47	81mm	34.00	Vertical
677683.47	1167133.54	a48	rocket motor	12.00	Vertical
677680.56	1167145.54	a49	3 "stokes	20.00	Vertical
677674.37	1167119.69	a50	37mm	2.00	Horizontal
677753.19	1167226.71	NE	corner point		
677651.45	1167138.05	NW	corner point		
677762.26	1167147.30	M1	mid point		
677728.18	1167117.92	M2	mid point		
677685.25	1167167.49	M3	mid point		
677719.52	1167196.53	M4	mid point		

TABLE A-2: CORNER POINTS

Corner Point	X	Y
SW	677693.96	1167088.76
SE	677796.54	1167176.86
NE	677753.19	1167226.71
NW	677651.45	1167138.05
M1	677762.26	1167147.30
M2	677728.18	1167117.92
M3	677685.25	1167167.49
M4	677719.52	1167196.53

APPENDIX B

FIGURES

Geophysical Prove-Out Work Plan
Fort McClellan, Alabama

FIGURE B-1: TEST GRID LOCATION

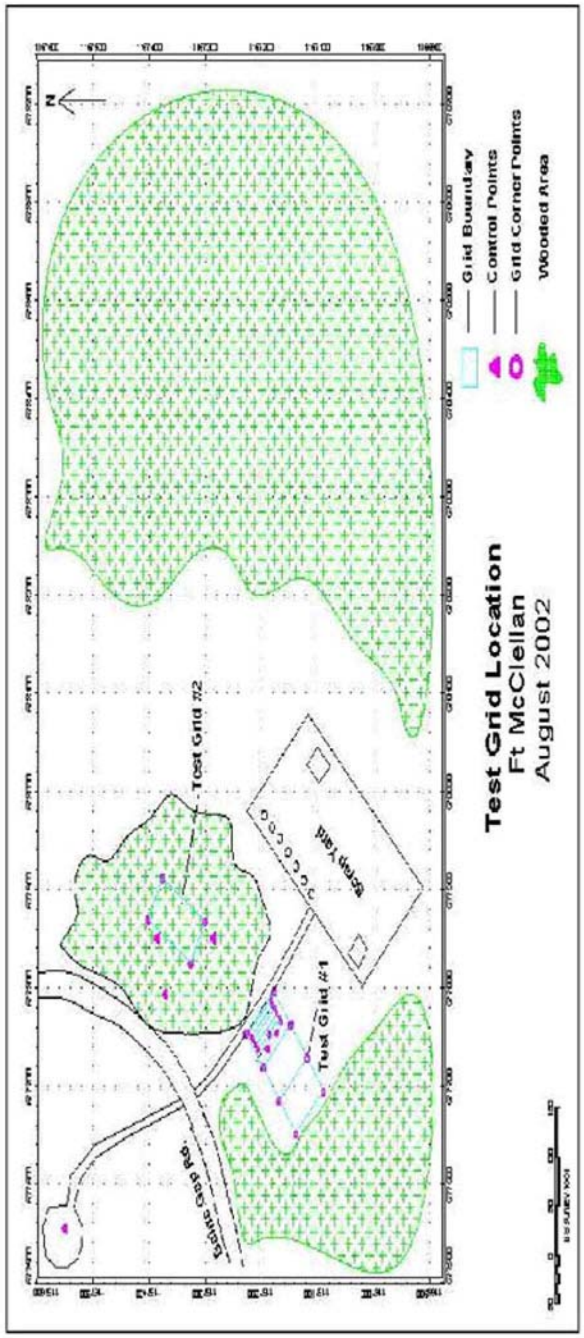

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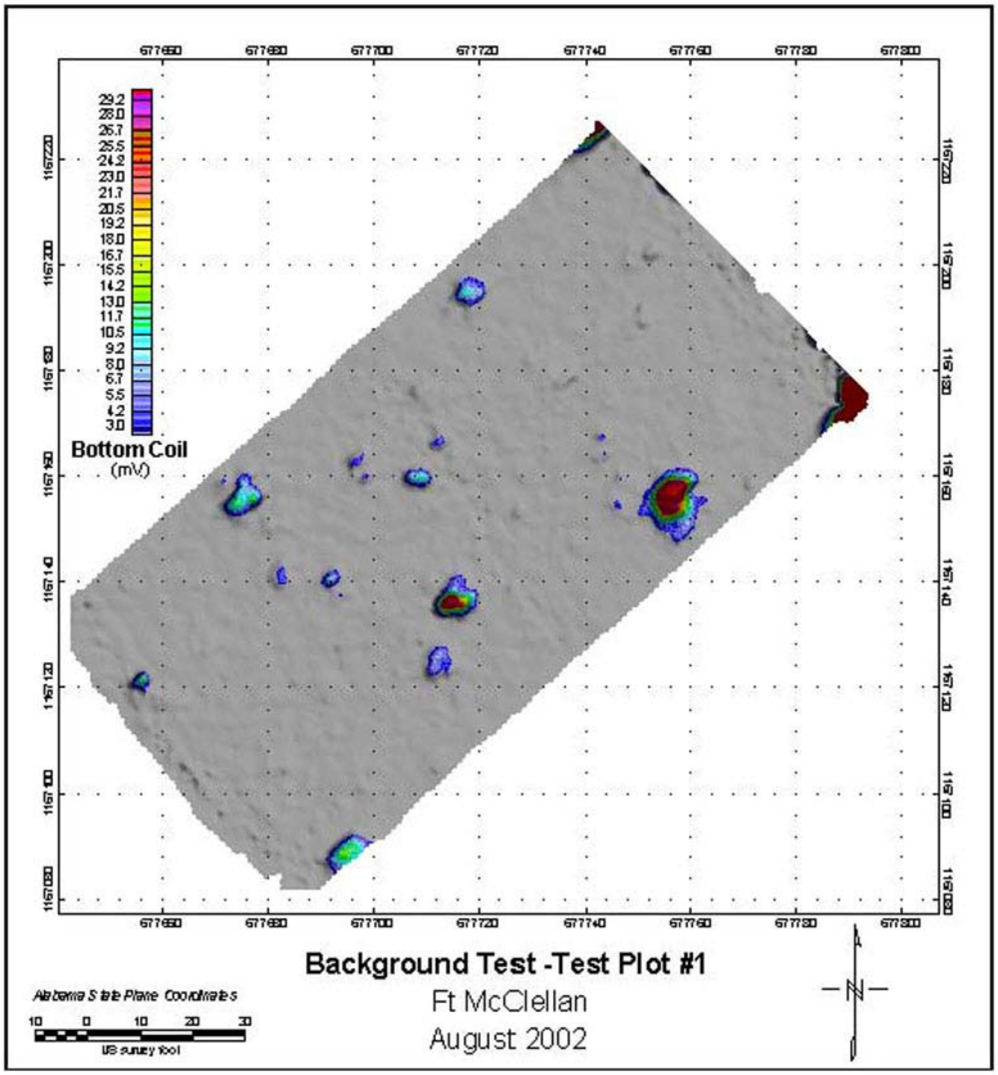
FIGURE B-2: BACKGROUND TEST



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Final
Geophysical Prove-Out
Letter Report

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Final
Geophysical Prove-Out
Letter Report
Fort McClellan, Alabama

Task Order 0010
Contract Number DACA87-99-D-0010

U.S. Army Corps of Engineers
Engineering and Support Center
Huntsville, Alabama

Prepared by
Tetra Tech
Huntsville, Alabama

August 2005

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LIST OF APPENDICIES

1.0 INTRODUCTION

The United States Army Engineering and Support Center, Huntsville (USAESCH) has contracted Tetra Tech EC Inc. (TtEC) under Contract DACA87-99-D-0010, to perform a Geophysical Prove-Out (GPO) at Fort McClellan located in Anniston, Alabama. The GPO was performed during the week of August 1st, 2005. Essential aspects of the GPO will be discussed in the following report with additional information, to include all digital data, provided on the CD-ROM submitted as a supplement to this report.

2.0 OBJECTIVE

A geophysical GPO serves many purposes. It allows the contractor to formulate a "plan of attack" regarding the selection of equipment, personnel and procedures to be used during the mapping and reacquire phases of the project. It is also allows the contractor to "iron out" any potential problems in the numerous elements associated with a geophysical survey. The GPO also offers the contractor an opportunity to demonstrate their capabilities for clients and regulators. These objectives are met by demonstrating and document the performance of the data acquisition methodology and spatial sampling protocols, sensor(s) and positioning equipment, data analysis and management systems, data transfer procedures, and the geophysical Quality Control (QC) system. In addition, the GPO test was used to validate each team member's ability to perform his or her required task. The following components of the geophysical system were evaluated during the GPO field program to ensure the program objectives were met:

- Spatial sample density (i.e., line and station spacing)
- Navigation and positioning methodologies
- Sensor and positioning system platform (stability, noise characteristics, and ergonomics)
- Data processing, analysis and interpretation, management, and transfer system
- Quality Assurance (QA) Control, documentation protocol for data acquisition, processing and analysis, and data management and transfer

The GPO test grid was designed and placed in a location were it can be maintained for ongoing usage. It is the intention of TtEC to validate our geophysical systems throughout the duration of the present contract as well as any subsequent removal actions. These validations will occur based on modifications to the geophysical sensors, positioning equipment, or acquisition/reacquisition procedures that affect the accuracy and/or repeatability of the data and cannot be assessed in real-time during normal field operations.

3.0 LOCATION

The GPO area is located near the scrap yard off of Bains Gap Road (see Appendix A). The GPO area is representative of the environment encountered during geophysical operations at Fort McClellan including wooded areas, tree lines, roads, high brush, cultural features and open areas. Two test grids were constructed in this area. Test grid #1 was used for this GPO.

4.0 EQUIPMENT

Based on our previous experience at numerous UXO sites, the EM61 MK2 instrument was selected because it has exhibited the best potential to meet the similar program objectives. TtEC has evaluated the following equipment in the GPO test grid. Two positioning systems were selected for evaluation due to the potential for multiple environmental conditions.

4.1 EM61 MK2

The EM61 MK2 performed well and is suitable for the task as discussed in the following sections describing the various tests performed.

4.2 Differentially Corrected Global Positioning

DGPS faired well in the open areas, however, as anticipated, satellite visibility was limited up to 25 feet off of the tree line of the GPO. The results are located in Appendix G. Pauses in the data set also caused spikes in the positioning data. Processing methods allowed for much of the positioning data to be corrected however if similar tree cover exists within the area of interest, another method of position will be required and utilized. Based on our observations, satellite configuration appeared to be the most effective variable to observe in determining the potential for accurate DGPS. In Northern Alabama, it appears that in the afternoon, the available satellites are very low on the horizon. Although the available satellites register 9-11, the configuration of the satellites did not support a good solution. For this reason, satellite configuration will be monitored in all areas. During the reacquisition phase of the GPO the DGPS system was effective in reacquiring along the tree line. This is due to the operator's ability to remain stationary for a period of time allowing time to obtain differential lock.

4.3 Robotic Total Station

The RTS will be utilized as the positioning method, as needed, in areas were DGPS is compromised due to a dense tree line. The RTS utilizes line-of-site, therefore when setting up facing the tree line there are no obstructions. The RTS coupled with the EM61 MK2 successfully demonstrated the ability to accurately detect 49 of the 50 seeded items. The results are located in Appendix G.

4.4 Seeded Items

All seeded items were buried by qualified UXO personnel following a background survey of the test grid during the original design (see Appendix B). All items detected during the background survey, were removed from the ground. Photographs of the seeded items will be submitted on a CD-ROM. Locations of the items can be found in Appendix C.

5.0 PROCEDURES

5.1 DATA ACQUISITION

Data was acquired at a line spacing of 2.5 –3.0-ft and at a sample rate of 12-15 times per second. The along line sampling is between 4.0 and 5.0 samples/ft depending on the operator's speed which can vary slightly based on terrain. Line spacing was erratic (greater than 3.0 feet) along the tree line in DGPS mode. Full coverage was obtained in the open areas. The RTS obtained full coverage throughout the GPO and was not effected by the near by trees. Prior to starting the acquisition session, the coil height was measured to 15 inches above ground level. Shake tests were performed to verify that all cables were secure in position. The original shake test did not reveal any changes in the EM61 MK2 readings, however a second, more rigorous shake test determined that one of the EM61 MK2 Batteries contained a loose wire, which caused dropouts in the data readings. A second RTS data set was collected utililizing a new battery which corrected the problem. These results can be found in appendix G. The three time-gates were electronically nulled to zero in a magnetically "quiet" area using the Geonics MK2 acquisition software. Following these procedures, static and dynamic data were recorded to facilitate shift and drift corrections. The operators who will be acquiring data in the field collected the data in the GPO.

5.2 DATA PROCESSING

Data were stored on PCMCIA cards during data acquisition. After acquisition on the test grid was completed, data was transferred from the PCMCIA cards to the site laptop PC for processing. A TtEC geophysicist performed preliminary geophysical and navigation data processing and Quality Control (QC) checks. The final analysis and interpretation of the data was performed at the TtEC processing center at Ft. McClellan, Alabama. Processing was performed with internally developed software that has been specifically produced to integrate and interpret digital geophysical data acquired with the DGPS and RTS Positioning Systems. Geosoft Oasis Montaj Mapping software was also used to graphically display data and select targets. Data transfer was fully tested during the GPO. This included the transfer of raw EM and positioning data. Corrected and leveled processed data were converted to column delimited ASCII format and delivered to the reacquisition team as a dig sheet this dig sheet is Table 3 of Appendix C.

5.3 REACQUISITION

Target reacquisition accuracy was evaluated by reacquiring anomalies selected by the project geophysicist. The same procedures and personnel to be used for anomaly reacquisition during the removal action were used in the GPO. These results can be found on Table 4 in Appendix C for both the DGPS and RTS data. DGPS was used to reacquire both data sets. Although Adversely effected by the near by trees in dynamic mode, the DGPS system proved effective in static mode. Differential lock was obtained when the system remained stationary for a short period of time (10-15 seconds). Only a small percentage of the area of interest contains wooded areas therefore this will not significantly effect scheduling. All the anomalies were reacquired per the geophysical target selections and plastic flags placed in the ground at that location. The reacquisition team then used the Vallon to "pinpoint" the location of the targets by utilizing the audible signal produced by the handheld detector. If the operator changed the flag location, the new location was measured utilizing the DGPS system. Following the reacquisition of the DGPS data, 48 of the 50 (96%) anomalies were located or were relocated to within 35cm of the known location. The RTS system was successful in 49 of the 50 anomalies (98%) for both sessions. No relocation of anomalies was required for the second RTS session because the selected location was within 35 cm of the known location on 49 of the 50 items. Both systems did not detect a horizontal 37mm (anomaly #a29) buried near the southeast corner of the grid at 16 inches. This anomaly was seeded by the project geophysicist several years ago as the designated "hard to find" item due to the size, depth and proximity to the corner point which has a large vertical nail in place which masks the signature of the deep small item. Another anomaly of interest was Anomaly #a4, a Horizontal 2.36 inch rocket buried to 26 inches. Both systems produced offsets greater then 18 inches when comparing the "picked" location to the known location. During the validation of the DGPS data, the reacquire team was not successful in relocating the item. However, during the RTS data reacquisition validation process, the anomaly was successfully pinpointed to the known location. An attributing factor to the success of relocating this item during the 2nd session (RTS) was the feedback process. This is a very important process for TtEC. Intrusive, reacquisition, quality control and the project geophysicist have an open line of communication during all phases of the project including reacquisition. When items are not located or detected by the reacquisition team, which appear on the geophysical map as strong hits, the project geophysicist is notified in real-time and corrective action is taken. In the case of anomaly #a4, the TtEC quality control specialist assisted in "tuning" the Vallon to be more effective in the GPO environment. Following these adjustments, the deep anomaly was successfully located. The feedback process remains one of the more effective tools in the entire process. The offset exhibited in both datasets by the deep horizontal elongated rocket was produced by an anomaly selection on only one end of the item.

5.4 Quality Control

Instrument and functionality checks were performed at the beginning and end of every data acquisition session during the GPO. Independent QC tests performed included static test, line test and positioning (cloverleaf) test.

5.5 Static Tests

The static test involved locating the instrument over a quiet area and recording data for 5 minutes, then placing a spherical item under the instrument and recording an additional 5 minutes of data. Each of the instrument configuration static tests showed normal background noise levels (0 to 2 mV for the bottom coil and 0 to 4 mV for the upper coil. Slight variations were due to normal instrument noise and the operator reacting to the many insects swarming around which caused slight movement due to slapping motions. The operator moving caused noise below the inherent system noise (movement noise in the order of 0.1-0.15 mV) therefore would not effect field operations. The figures located in Appendix D represent the static calibration and static response. The purpose is to inspect the consistency of the instrument response throughout the course of the project.

5.6 SIX-LINE TESTS

The six-line test (see Appendix E) involved collecting data along a 60-foot line six times. The purpose of this line test was to determine noise due to system movement/motion as well as location error caused by temporal time lag or spatial correction due to waypoint placement. For the first two line tests, data was collected along the line in each direction (Lines 1 and 2) at a normal pace over an item. Lines 3 and 4 were collected (with the item in place) at a fast pace followed by lines 5 and 6 collected at a slow pace. There was no appreciable noise increase from the tests nor was there appreciable position lag errors. A secondary subsurface anomaly was detected along the line as seen in the figure, located in Appendix E. The test was performed along the dirt road adjacent to the GPO test grid.

5.7 POSITIONING TESTS

To test the positioning, the navigation unit recorded data in a cloverleaf pattern around corner point SE, which is a known point (see Appendix F for figure), with the operator crossing over the known points from 3 different directions. The line path was then plotted over the known point. The results showed an offset of less then 2 inches between the known points and the operators "cross-over" intersection. There was no loss of signal during the test and the overall quality of the line path was good.

5.8 PERSONNEL AND SHAKE TESTS

The personnel test was performed by having the one operator approach the EM61 while one operator monitored the signal. The personnel test did reveal metallic pocket buckles on one of the operators. The buckles were promptly severed from the operator. Additionally both operators were checked for metallic objects, which may interfere with the EM signal. A wristwatch was also removed from one of the operators. The original shake test did not reveal any changes in the EM61 MK2 readings, however a second, more rigorous shake test determined that one of the EM61 MK2 Batteries contained a loose wire, which caused dropouts in the data readings. The battery was removed from operations.

Figure 1- removing pocket buckle (platinum ring not detected)

5.9 SUMMARY

TtEC will utilize one (1) 2-man team to acquire geophysical data in support of the Eastern Bypass Removal Action Construction Debris Project. The team demonstrated the ability to successfully meet the project objectives. Utilizing the EM61 MK2, the team confidently detected all of the seeded items except for seed item #a29. Using the EM61 MK2 coupled with DGPS, the data was of poor quality along the tree line and if encountered during field operations, RTS will be used. Based on these results, operators will continually monitor satellite configurations to ensure a good solution. The figures located in Appendix G show the 366-time gate from the Bottom coil for the EM61 MK2 coupled with both positioning systems The interpretation of the pick locations can be found in Appendix C of this document. The noise level on the Bottom Coil was in the order of 0.25mV.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS AND RECOMMENDATIONS

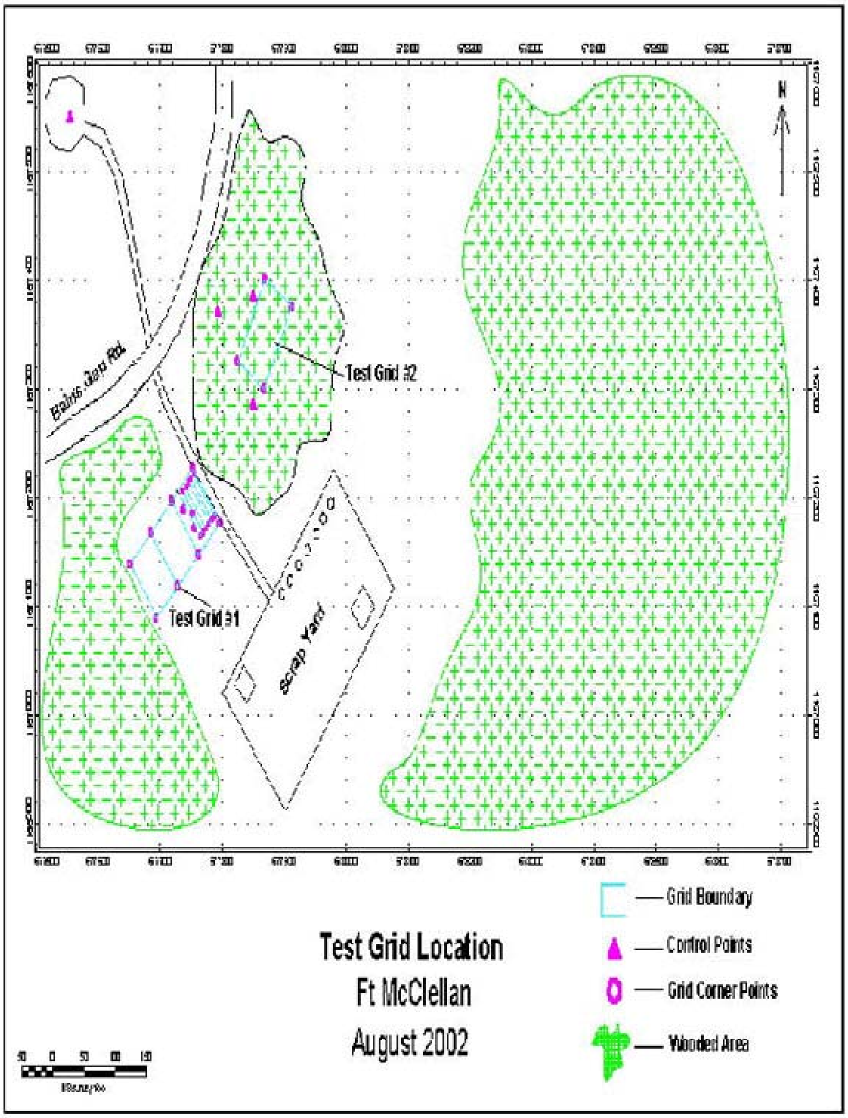
The GPO test grid at Fort McClellan is a very good indication of the types of areas that will be surveyed during the removal action. It is anticipated that trees, cultural features and open areas will all be encountered on a daily basis. The items seeded in the prove-out are also representative of the items to be encountered during the investigation and have accurate depth and location calculations.

The GPO was conducted to demonstrate and document the performance of the proposed data acquisition methodology (including personnel) and spatial sampling protocols, sensor(s) and positioning equipment, data analysis and management systems, data transfer procedures, and the geophysical Quality Control (QC) system.

Based on the results described previously in this report, the EM61 MK2 demonstrated the ability to meet the program objectives and should be approved for continual work. DGPS should only be used in areas free of tall trees and overhanging limbs. It is recommended that the line-of-site RTS method be implemented should these areas be encountered. It is recommended that TtEC continue to utilize the feedback process to ensure anomaly recovery.

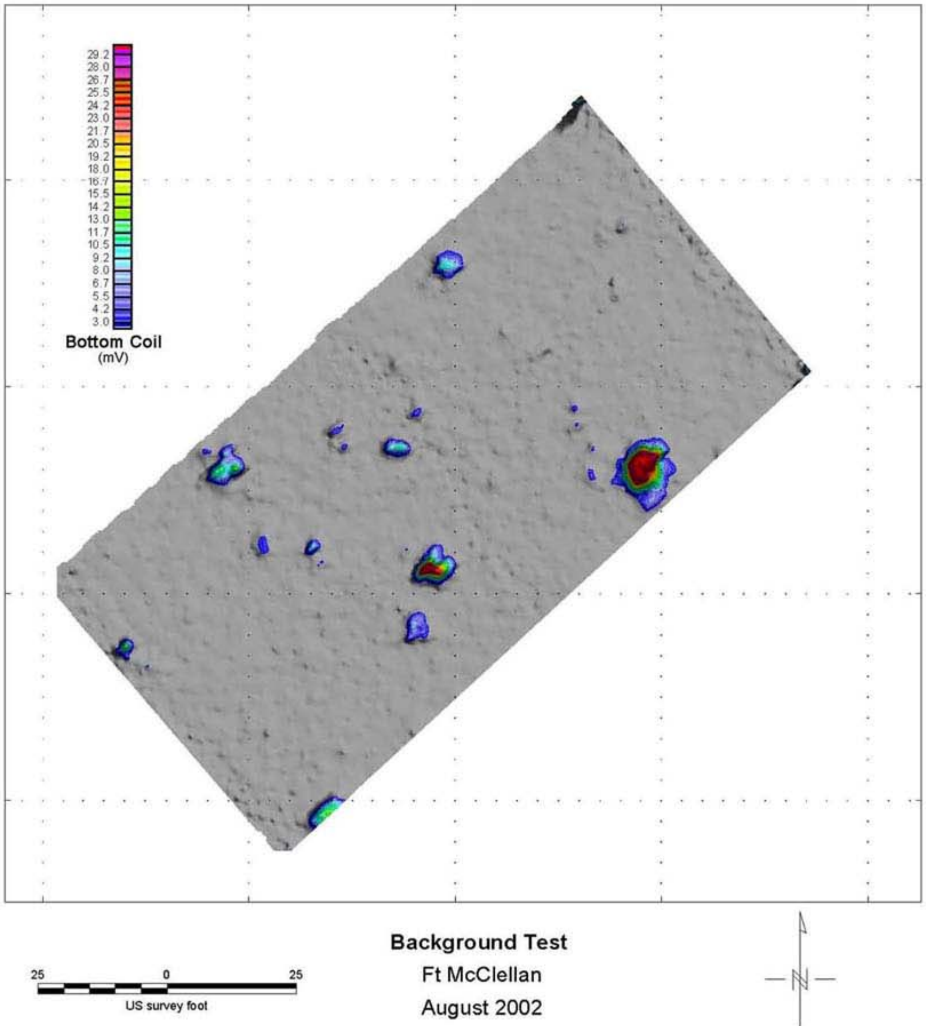
APPENDIX A

TEST GRID LOCATION


Bains Gap Rd.
Test Grid #2
Test Grid #1
Scrap Yard
N
Grid Boundary
Control Points
Grid Corner Points
Wooded Area
Test Grid Location
Ft McClellan
August 2002

APPENDIX B

BACKGROUND TEST GRID



Background Test
Ft McClellan
August 2002

APPENDIX C

TABLES

TABLE 1
SEED ITEMS

X	Y	TARGET ID	ITEM	DEPTH(IN)	ORIENTATION
677699.94	1167164.58	a1	37mm	4.00	Horizontal
677708.37	1167173.14	a2	37mm	4.00	Vertical
677719.73	1167188.12	a3	81mm	34.00	Horizontal
677721.10	1167175.99	a4	2.36" rocket	26.00	Horizontal
677730.10	1167179.32	a5	rocket motor	12.00	Horizontal
677723.37	1167167.69	a6	37mm	16.00	Horizontal
677735.00	1167169.03	a7	60mm	12.00	Vertical
677735.62	1167156.66	a8	MKII HG	8.00	Vertical
677745.30	1167155.03	a9	2.36" rocket	6.00	Vertical
677743.41	1167136.92	a10	Anti Tank Mine	6.00	Horizontal
677726.67	1167132.67	a11	60mm	6.00	Vertical
677718.25	1167118.37	a12	MKII HG	4.00	Horizontal
677719.58	1167146.36	a13	37mm	0.00	Horizontal
677688.23	1167097.99	a14	3 "stokes	20.00	Horizontal
677704.27	1167108.58	a15	3 "stokes	32.00	Horizontal
677694.61	1167113.24	a16	75mm	30.00	Horizontal
677709.18	1167133.61	a17	60mm	25.00	45 degrees
677691.87	1167128.25	a18	75mm	12.00	Vertical
677681.35	1167118.85	a19	MKII HG	14.00	Horizontal
677673.49	1167132.86	a20	75mm	18.00	45 degrees
677666.45	1167141.88	a21	37mm	4.00	45 degrees
677680.90	1167152.03	a22	slap flare	4.00	45 degrees
677706.20	1167151.98	a23	105mm	45.00	45 degrees
677753.84	1167216.57	a24	37mm	4.00	Horizontal
677765.13	1167208.06	a25	37mm	4.00	Vertical
677771.70	1167196.19	a26	81mm	17.00	Horizontal
677771.95	1167190.79	a27	2.36" rocket	26.00	Horizontal
677781.41	1167187.60	a28	rocket motor	12.00	Horizontal
677794.28	1167178.14	a29	37mm	16.00	Horizontal
677775.16	1167162.11	a30	60mm	12.00	Vertical
677767.82	1167173.71	a31	MKII HG	8.00	Vertical
677763.33	1167167.94	a32	2.36" rocket	6.00	Vertical
677750.42	1167179.97	a33	60mm	6.00	Horizontal
677756.51	1167195.77	a34	60mm	6.00	Vertical
677740.94	1167197.48	a35	MKII HG	4.00	Horizontal
677741.04	1167180.67	a36	37mm	0.00	Horizontal
677728.58	1167178.52	a37	3 "stokes	20.00	Horizontal
677733.40	1167171.79	a38	3 "stokes	32.00	Horizontal

TABLE 1
SEED ITEMS

X	Y	TARGET ID	ITEM	DEPTH(IN)	ORIENTATION
677743.27	1167161.79	a39	75mm	30.00	Horizontal
677758.76	1167148.27	a40	81mm	25.00	45 degrees
677697.46	1167163.21	a41	75mm	12.00	Vertical
677699.23	1167155.70	a42	MKII HG	0.00	Horizontal
677700.11	1167144.91	a43	75mm	18.00	45 degrees
677715.77	1167137.08	a44	37mm	4.00	45 degrees
677715.85	1167112.69	a45	slap flare	4.00	Vertical
677706.94	1167104.36	a46	105mm	10.00	Vertical
677693.62	1167134.69	a47	81mm	34.00	Vertical
677683.47	1167133.54	a48	rocket motor	12.00	Vertical
677680.56	1167145.54	a49	3 "stokes	20.00	Vertical
677674.37	1167119.69	a50	37mm	2.00	Horizontal
677753.19	1167226.71	NE	corner point		
677651.45	1167138.05	NW	corner point		
677762.26	1167147.30	M1	mid point		
677728.18	1167117.92	M2	mid point		
677685.25	1167167.49	M3	mid point		
677719.52	1167196.53	M4	mid point		

TABLE 2
CORNER POINTS

CORNER POINT	X	Y
SW	677693.96	1167088.76
SE	677796.54	1167176.86
NE	677753.19	1167226.71
NW	677651.45	1167138.05
M1	677762.26	1167147.30
M2	677728.18	1167117.92
M3	677685.25	1167167.49
M4	677719.52	1167196.53

TABLE 3
GPS DIGSHEET

TargetID	X	Y	Estdepth (ft)	Top	Bottom	C1C2 Ratio	Priority	Comments	Date	Comments
1	677699.71	1167164.44	2.07	24.96	22.05	1.13	dig	ok	8/2/2005	
2	677709.35	1167173.64	1.29	17.83	17.68	1.01	dig	ok	8/2/2005	
3	677719	1167186.99	1.35	4.63	4.55	1.02	dig	ok	8/2/2005	
4	677721.52	1167173.34	1.14	4.8	4.87	0.99	dig	ok	8/2/2005	
5	677730.28	1167178.53	1.59	44.19	41.83	1.06	dig	ok	8/2/2005	
6	677723.15	1167166.52	1.39	5.46	5.33	1.02	dig	ok	8/2/2005	
7	677735.05	1167169.05	1.69	37.1	34.64	1.07	dig	ok	8/2/2005	
8	677735.52	1167156.05	0.52	7.96	8.86	0.9	dig	ok	8/2/2005	
9	677745.53	1167154.85	1.38	118.87	116.25	1.02	dig	ok	8/2/2005	
10	677743.6	1167136.62	1.08	823.52	843.51	0.98	dig	ok	8/2/2005	
11	677726.56	1167132.73	1.72	37.53	34.89	1.08	dig	ok	8/2/2005	
12	677718.2	1167117.95	0.81	5.79	6.18	0.94	dig	ok	8/2/2005	
13	677720.74	1167145.6	0	17.19	23.58	0.73	dig	ok	8/2/2005	
14	677688.3	1167097.82	2.31	24.91	21.33	1.17	dig	ok	8/2/2005	
15	677703.25	1167108.09	4.25	8.3	5.87	1.41	dig	ok	8/2/2005	
16	677695.03	1167112.72	6.07	6.48	4.09	1.58	dig	ok	8/2/2005	
17	677709.31	1167134	2.64	7.8	6.42	1.21	dig	ok	8/2/2005	
18	677691.97	1167128.13	2	42.63	38.07	1.12	dig	ok	8/2/2005	
19	677681.28	1167117.81	0.3	2.95	3.38	0.87	dig	ok	8/2/2005	
20	677674.54	1167132.6	1.67	17.37	16.26	1.07	dig	ok	8/2/2005	
21	677666.62	1167143.37	0.37	18.98	21.55	0.88	dig	ok	8/2/2005	
22	677681.42	1167153.23	0	8.59	10.26	0.84	dig	ok	8/2/2005	
23	677706.98	1167152.19	1.95	3.97	3.57	1.11	dig	ok	8/2/2005	
24	677752.99	1167217.93	0	17.98	21.8	0.82	dig	ok	8/2/2005	
25	677764.35	1167206.72	0.89	28.79	30.33	0.95	dig	ok	8/2/2005	
26	677771.23	1167195.21	1.25	19.43	19.4	1	dig	ok	8/2/2005	
27	677771.68	1167188.63	0.14	12.68	14.85	0.85	dig	ok	8/2/2005	
28	677779.9	1167187.44	3.22	8.82	6.82	1.29	dig	ok	8/2/2005	
29	677774.67	1167161.13	1	14.55	15.09	0.96	dig	ok	8/2/2005	
30	677767.49	1167172.79	0.89	10.61	11.18	0.95	dig	ok	8/2/2005	
31	677763.01	1167168.01	1.57	73.84	70.18	1.05	dig	ok	8/2/2005	
32	677750.6	1167179.52	0	33.78	40.56	0.83	dig	ok	8/2/2005	
33	677756.43	1167195.06	1.25	55.78	55.65	1	dig	ok	8/2/2005	
34	677740.89	1167197.01	0.11	6.95	8.17	0.85	dig	ok	8/2/2005	
35	677740.75	1167179.67	0	15.73	20.48	0.77	dig	ok	8/2/2005	
36	677728.49	1167177.43	1.59	44.19	41.83	1.06	dig	ok	8/2/2005	
37	677732.83	1167171.3	3.65	20.28	15.07	1.35	dig	ok	8/2/2005	
38	677742.84	1167161.44	4.77	5.62	3.83	1.47	dig	ok	8/2/2005	
39	677758.84	1167147.39	1.99	14.54	12.99	1.12	dig	ok	8/2/2005	
40	677697.41	1167162.63	1.97	35.81	32.11	1.12	dig	ok	8/2/2005	
41	677698.91	1167155.76	1.03	7.77	8.02	0.97	dig	ok	8/2/2005	
42	677699.66	1167144.55	1.59	18.39	17.41	1.06	dig	ok	8/2/2005	

TABLE 3
GPS DIGSHEET

TargetID	X	Y	Estdepth (ft)	Top	Bottom	C1C2 Ratio	Priority	Comments	Date	Comments
43	677715.65	1167135.58	1.07	14	14.37	0.97	dig	ok	8/2/2005	
44	677715.06	1167112.12	3.36	8.14	6.21	1.31	dig	ok	8/2/2005	
45	677706.54	1167104.95	2.14	18.88	16.54	1.14	dig	ok	8/2/2005	
46	677693.23	1167134.69	1.67	123.06	115.21	1.07	dig	ok	8/2/2005	
47	677683.66	1167135.43	2.64	51.12	42.07	1.22	dig	ok	8/2/2005	
48	677679.92	1167146.49	0.45	4.63	5.2	0.89	dig	ok	8/2/2005	
49	677674.53	1167118.84	0	21.43	26.39	0.81	dig	ok	8/2/2005	
50	677716.82	1167163.08	0	1.49	3.35	0.44	dig	ok	8/2/2005	
51	677728.16	1167117.93	1.06	22.32	22.93	0.97	dig	midpoint	8/2/2005	

TABLE 4
REACQUIRE RESULTS

X	Y	TargetID	Item	Depth(in)	Orientation	ReaquireX	ReaquireY	OffsetX(ft)	OffsetY(ft)
677699.94	1167164.58	a1	37mm	4.00	Horizontal	677699.71	1167164.44	0.23	0.14
677708.37	1167173.14	a2	37mm	4.00	Vertical	677709.35	1167173.64	-0.98	-0.50
677719.73	1167188.12	a3	81mm	34.00	Horizontal	677719.00	1167186.99	0.73	1.13
677721.10	1167175.99	a4	2.36" rocket	26.00	Horizontal	677721.52	1167173.34	-0.42	2.65
677730.10	1167179.32	a5	rocket motor	12.00	Horizontal	677730.28	1167178.53	-0.18	0.79
677723.37	1167167.69	a6	37mm	16.00	Horizontal	677723.15	1167166.52	0.22	1.17
677735.00	1167169.03	a7	60mm	12.00	Vertical	677735.05	1167169.05	-0.05	-0.02
677735.62	1167156.66	a8	MKII HG	8.00	Vertical	677735.52	1167156.05	0.10	0.61
677745.30	1167155.03	a9	2.36" rocket	6.00	Vertical	677745.53	1167154.85	-0.23	0.18
677743.41	1167136.92	a10	Anti Tank Mine	6.00	Horizontal	677743.60	1167136.62	-0.19	0.30
677726.67	1167132.67	a11	60mm	6.00	Vertical	677726.56	1167132.73	0.11	-0.06
677718.25	1167118.37	a12	MKII HG	4.00	Horizontal	677718.20	1167117.95	0.05	0.42
677719.58	1167146.36	a13	37mm	0.00	Horizontal	677720.74	1167145.60	-1.16	0.76
677688.23	1167097.99	a14	3 "stokes	20.00	Horizontal	677688.30	1167097.82	-0.07	0.17
677704.27	1167108.58	a15	3 "stokes	32.00	Horizontal	677703.25	1167108.09	1.02	0.49
677694.61	1167113.24	a16	75mm	30.00	Horizontal	677695.03	1167112.72	-0.42	0.52
677709.18	1167133.61	a17	60mm	25.00	45 degrees	677709.31	1167134.00	-0.13	-0.39
677691.87	1167128.25	a18	75mm	12.00	Vertical	677691.97	1167128.13	-0.10	0.12
677681.35	1167118.85	a19	MKII HG	14.00	Horizontal	677681.28	1167117.81	0.07	1.04
677673.49	1167132.86	a20	75mm	18.00	45 degrees	677674.54	1167132.60	-1.05	0.26
677666.45	1167141.88	a21	37mm	4.00	45 degrees	677666.62	1167143.37	-0.17	-1.49
677680.90	1167152.03	a22	slap flare	4.00	45 degrees	677681.42	1167153.23	-0.52	-1.20
677706.20	1167151.98	a23	105mm	45.00	45 degrees	677706.98	1167152.19	-0.78	-0.21
677753.84	1167216.57	a24	37mm	4.00	Horizontal	677752.99	1167217.93	0.85	-1.36
677765.13	1167208.06	a25	37mm	4.00	Vertical	677764.35	1167206.72	0.78	1.34
677771.70	1167196.19	a26	81mm	17.00	Horizontal	677771.23	1167195.21	0.47	0.98
677771.95	1167190.79	a27	2.36" rocket	26.00	Horizontal	677771.68	1167188.63	0.27	2.16
677781.41	1167187.60	a28	rocket motor	12.00	Horizontal	677779.90	1167187.44	1.51	0.16
677794.28	1167178.14	a29	37mm	16.00	Horizontal	na	na	na	na
677775.16	1167162.11	a30	60mm	12.00	Vertical	677774.67	1167161.13	0.49	0.98
677767.82	1167173.71	a31	MKII HG	8.00	Vertical	677767.49	1167172.79	0.33	0.92
677763.33	1167167.94	a32	2.36" rocket	6.00	Vertical	677763.01	1167168.01	0.32	-0.07
677750.42	1167179.97	a33	60mm	6.00	Horizontal	677750.60	1167179.52	-0.18	0.45
677756.51	1167195.77	a34	60mm	6.00	Vertical	677756.43	1167195.06	0.08	0.71
677740.94	1167197.48	a35	MKII HG	4.00	Horizontal	677740.89	1167197.01	0.05	0.47
677741.04	1167180.67	a36	37mm	0.00	Horizontal	677740.75	1167179.67	0.29	1.00
677728.58	1167178.52	a37	3 "stokes	20.00	Horizontal	677728.49	1167177.43	0.09	1.09
677733.40	1167171.79	a38	3 "stokes	32.00	Horizontal	677732.83	1167171.30	0.57	0.49
677743.27	1167161.79	a39	75mm	30.00	Horizontal	677742.84	1167161.44	0.43	0.35
677758.76	1167148.27	a40	81mm	25.00	45 degrees	677758.84	1167147.39	-0.08	0.88
677697.46	1167163.21	a41	75mm	12.00	Vertical	677697.41	1167162.63	0.05	0.58
677699.23	1167155.70	a42	MKII HG	0.00	Horizontal	677698.91	1167155.76	0.32	-0.06

TABLE 4
REACQUIRE RESULTS

X	Y	TargetID	Item	Depth(in)	Orientation	ReaquireX	ReaquireY	OffsetX(ft)	OffsetY(ft)
677700.11	1167144.91	a43	75mm	18.00	45 degrees	677699.66	1167144.55	0.45	0.36
677715.77	1167137.08	a44	37mm	4.00	45 degrees	677715.65	1167135.58	0.12	1.50
677715.85	1167112.69	a45	slap flare	4.00	Vertical	677715.06	1167112.12	0.79	0.57
677706.94	1167104.36	a46	105mm	10.00	Vertical	677706.54	1167104.95	0.40	-0.59
677693.62	1167134.69	a47	81mm	34.00	Vertical	677693.23	1167134.69	0.39	0.00
677683.47	1167133.54	a48	rocket motor	12.00	Vertical	677683.66	1167135.43	-0.19	-1.89
677680.56	1167145.54	a49	3 "stokes	20.00	Vertical	677679.92	1167146.49	0.64	-0.95
677674.37	1167119.69	a50	37mm	2.00	Horizontal	677674.53	1167118.84	-0.16	0.85

TABLE 4
REACQUIRE RESULTS RTS

X	Y	TargetID	Item	Depth (in)	Orientation	PickedX	PickedY	ReaquireX	ReaquireY	OffsetX from Reaquired(ft)	OffsetY from Reaquired(ft)	Total Offset
677699.94	1167164.58	a1	37mm	4.00	Horizontal	677700.10	1167164.62	677700.10	1167164.62	-0.16	-0.04	0.16
677708.37	1167173.14	a2	37mm	4.00	Vertical	677708.73	1167173.13	677708.73	1167173.13	-0.36	0.01	0.36
677719.73	1167188.12	a3	81mm	34.00	Horizontal	677719.52	1167187.02	677719.52	1167187.02	0.21	1.10	1.12
677721.10	1167175.99	a4	2.36" rocket	26.00	Horizontal	677721.55	1167174.56	677721.55	1167174.56	-0.45	1.43	1.50
677730.10	1167179.32	a5	rocket motor	12.00	Horizontal	677729.94	1167179.36	677729.94	1167179.36	0.16	-0.04	0.17
677723.37	1167167.69	a6	37mm	16.00	Horizontal	677723.35	1167166.77	677723.35	1167166.77	0.02	0.92	0.92
677735.00	1167169.03	a7	60mm	12.00	Vertical	677735.09	1167168.92	677735.09	1167168.92	-0.09	0.11	0.14
677735.62	1167156.66	a8	MKII HG	8.00	Vertical	677735.69	1167156.46	677735.69	1167156.46	-0.07	0.20	0.22
677745.30	1167155.03	a9	2.36" rocket	6.00	Vertical	677745.28	1167155.02	677745.28	1167155.02	0.02	0.01	0.03
677743.41	1167136.92	a10	Anti Tank Mine	6.00	Horizontal	677743.25	1167136.80	677743.25	1167136.80	0.16	0.12	0.20
677726.67	1167132.67	a11	60mm	6.00	Vertical	677726.71	1167132.73	677726.71	1167132.73	-0.04	-0.06	0.07
677718.25	1167118.37	a12	MKII HG	4.00	Horizontal	677717.97	1167118.00	677717.97	1167118.00	0.28	0.37	0.46
677719.58	1167146.36	a13	37mm	0.00	Horizontal	677720.12	1167146.16	677720.12	1167146.16	-0.54	0.20	0.57
677688.23	1167097.99	a14	3 "stokes	20.00	Horizontal	677688.50	1167097.99	677688.50	1167097.99	-0.27	0.00	0.27
677704.27	1167108.58	a15	3 "stokes	32.00	Horizontal	677703.96	1167108.54	677703.96	1167108.54	0.31	0.04	0.31
677694.61	1167113.24	a16	75mm	30.00	Horizontal	677694.97	1167113.33	677694.97	1167113.33	-0.36	-0.09	0.38
677709.18	1167133.61	a17	60mm	25.00	45 degrees	677709.22	1167134.40	677709.22	1167134.40	-0.04	-0.79	0.79
677691.87	1167128.25	a18	75mm	12.00	Vertical	677691.97	1167128.52	677691.97	1167128.52	-0.10	-0.27	0.29
677681.35	1167118.85	a19	MKII HG	14.00	Horizontal	677681.42	1167118.45	677681.42	1167118.45	-0.07	0.40	0.40
677673.49	1167132.86	a20	75mm	18.00	45 degrees	677673.99	1167132.84	677673.99	1167132.84	-0.50	0.02	0.50
677666.45	1167141.88	a21	37mm	4.00	45 degrees	677666.44	1167141.95	677666.44	1167141.95	0.01	-0.07	0.07
677680.90	1167152.03	a22	slap flare	4.00	45 degrees	677681.06	1167152.02	677681.06	1167152.02	-0.16	0.01	0.16
677706.20	1167151.98	a23	105mm	45.00	45 degrees	677706.11	1167152.02	677706.11	1167152.02	0.09	-0.04	0.10
677753.84	1167216.57	a24	37mm	4.00	Horizontal	677753.54	1167217.18	677753.54	1167217.18	0.30	-0.61	0.68
677765.13	1167208.06	a25	37mm	4.00	Vertical	677764.45	1167208.07	677764.45	1167208.07	0.68	-0.01	0.68
677771.70	1167196.19	a26	81mm	17.00	Horizontal	677772.24	1167196.09	677772.24	1167196.09	-0.54	0.10	0.55
677771.95	1167190.79	a27	2.36" rocket	26.00	Horizontal	677771.88	1167191.05	677771.88	1167191.05	0.07	-0.26	0.27
677781.41	1167187.60	a28	rocket motor	12.00	Horizontal	677781.58	1167187.22	677781.58	1167187.22	-0.17	0.38	0.42
677794.28	1167178.14	a29	37mm	16.00	Horizontal	na	na	na	na	na	na	na
677775.16	1167162.11	a30	60mm	12.00	Vertical	677774.89	1167161.35	677774.89	1167161.35	0.27	0.76	0.81
677767.82	1167173.71	a31	MKII HG	8.00	Vertical	677767.58	1167173.81	677767.58	1167173.81	0.24	-0.10	0.26
677763.33	1167167.94	a32	2.36" rocket	6.00	Vertical	677763.38	1167167.82	677763.38	1167167.82	-0.05	0.12	0.13
677750.42	1167179.97	a33	60mm	6.00	Horizontal	677750.44	1167179.80	677750.44	1167179.80	-0.02	0.17	0.18

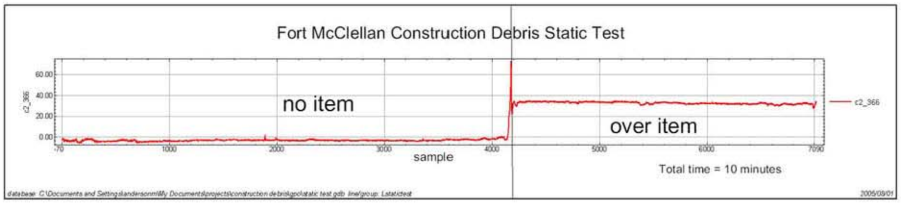
TABLE 4
REACQUIRE RESULTS RTS

X	Y	TargetID	Item	Depth (in)	Orientation	PickedX	PickedY	ReaquireX	ReaquireY	OffsetX from Reaquired(ft)	OffsetY from Reaquired(ft)	Total Offset
677756.51	1167195.77	a34	60mm	6.00	Vertical	677756.43	1167195.51	677756.43	1167195.51	0.08	0.26	0.27
677740.94	1167197.48	a35	MKII HG	4.00	Horizontal	677740.73	1167197.66	677740.73	1167197.66	0.21	-0.18	0.27
677741.04	1167180.67	a36	37mm	0.00	Horizontal	677741.21	1167180.65	677741.21	1167180.65	-0.17	0.02	0.17
677728.58	1167178.52	a37	3 "stokes	20.00	Horizontal	677728.63	1167178.49	677728.63	1167178.49	-0.05	0.03	0.06
677733.40	1167171.79	a38	3 "stokes	32.00	Horizontal	677733.42	1167171.90	677733.42	1167171.90	-0.02	-0.11	0.11
677743.27	1167161.79	a39	75mm	30.00	Horizontal	677743.13	1167161.83	677743.13	1167161.83	0.14	-0.04	0.14
677758.76	1167148.27	a40	81mm	25.00	45 degrees	677758.71	1167148.28	677758.71	1167148.28	0.05	-0.01	0.05
677697.46	1167163.21	a41	75mm	12.00	Vertical	677697.36	1167163.26	677697.36	1167163.26	0.10	-0.05	0.12
677699.23	1167155.70	a42	MKII HG	0.00	Horizontal	677699.04	1167155.71	677699.04	1167155.71	0.19	-0.01	0.19
677700.11	1167144.91	a43	75mm	18.00	45 degrees	677700.11	1167144.80	677700.11	1167144.80	0.00	0.11	0.11
677715.77	1167137.08	a44	37mm	4.00	45 degrees	677715.71	1167136.78	677715.71	1167136.78	0.06	0.30	0.31
677715.85	1167112.69	a45	slap flare	4.00	Vertical	677715.36	1167112.94	677715.36	1167112.94	0.49	-0.25	0.54
677706.94	1167104.36	a46	105mm	10.00	Vertical	677706.85	1167104.67	677706.85	1167104.67	0.09	-0.31	0.32
677693.62	1167134.69	a47	81mm	34.00	Vertical	677693.78	1167134.39	677693.78	1167134.39	-0.16	0.30	0.34
677683.47	1167133.54	a48	rocket motor	12.00	Vertical	677683.48	1167133.43	677683.48	1167133.43	-0.01	0.11	0.11
677680.56	1167145.54	a49	3 "stokes	20.00	Vertical	677680.12	1167145.54	677680.12	1167145.54	0.44	0.00	0.44
677674.37	1167119.69	a50	37mm	2.00	Horizontal	677674.37	1167119.77	677674.37	1167119.77	0.00	-0.08	0.08

indicated target relocated

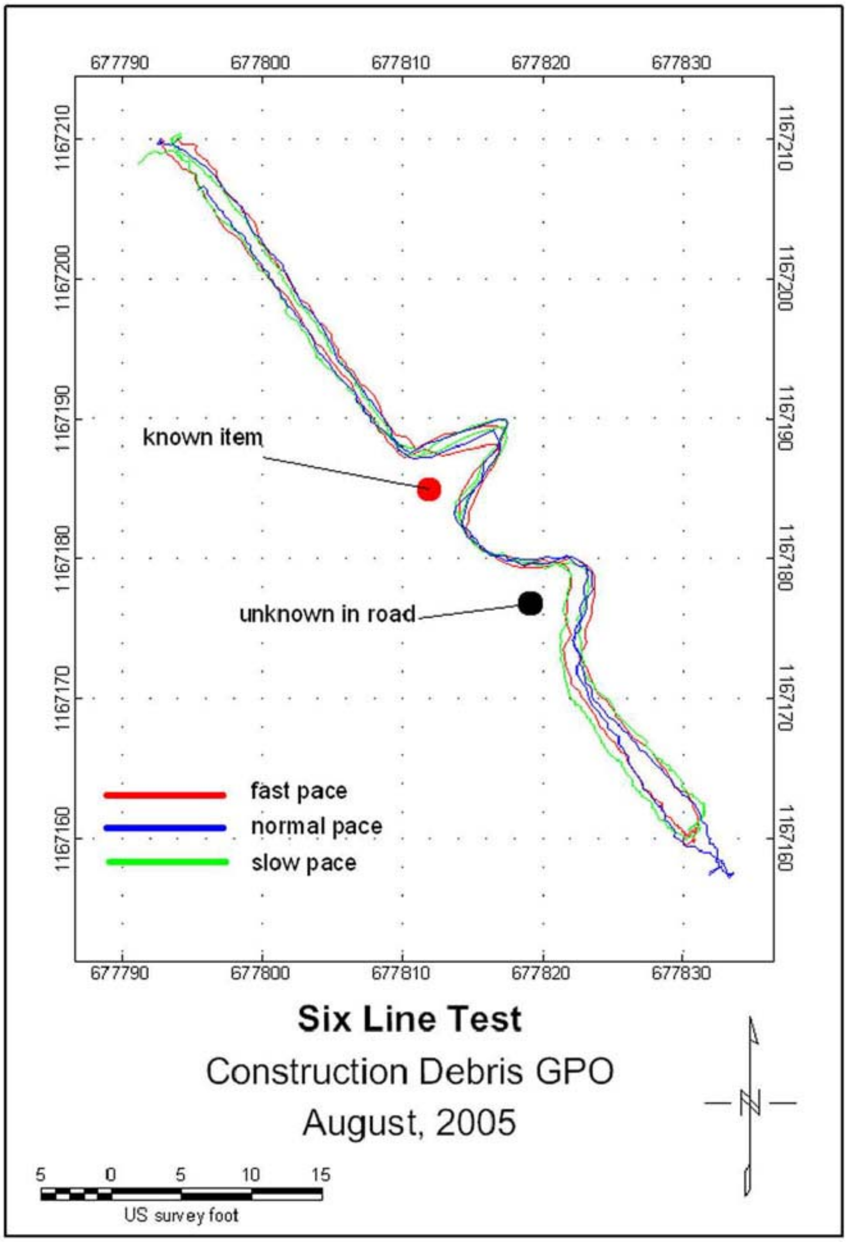
APPENDIX D

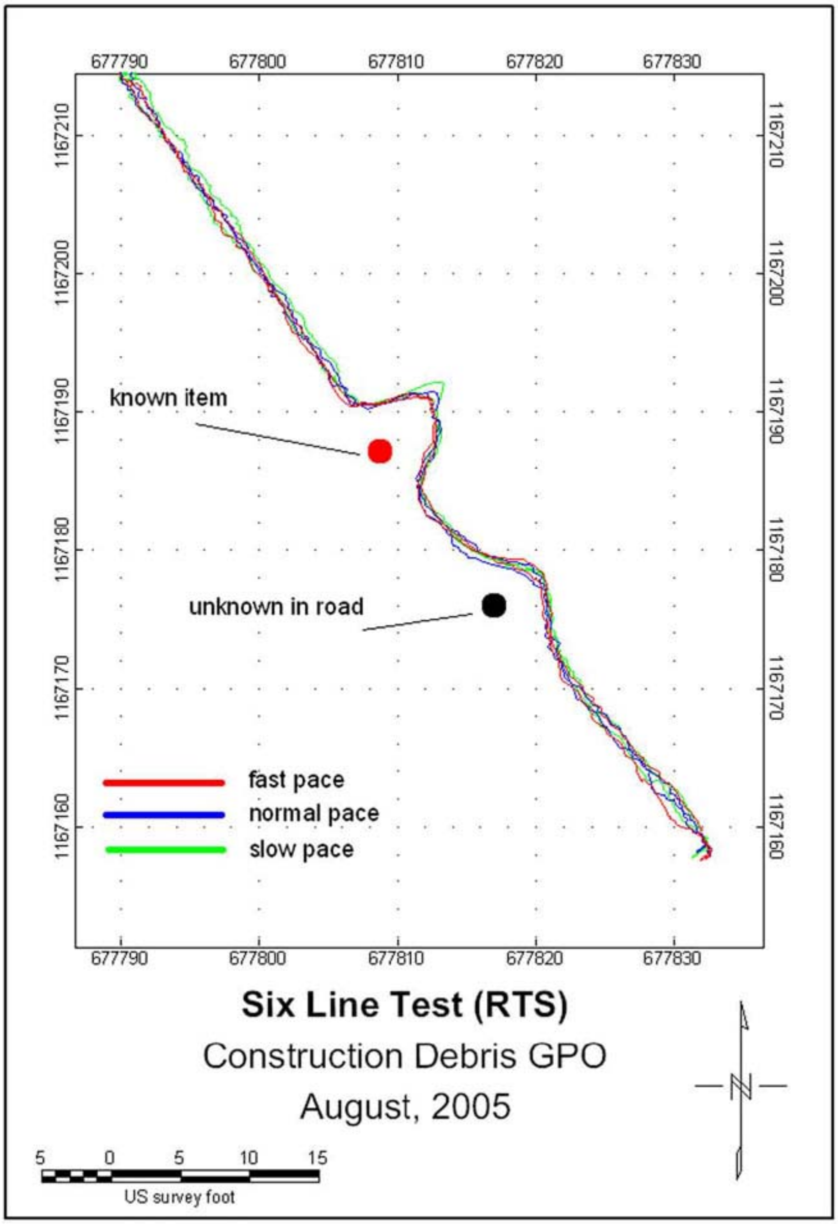
STATIC TEST


Fort McClellan Construction Debris Static Test
60.00
40.00
20.00
0.00
c2_366
no item
over item
-70
1000
2000
3000
4000
5000
6000
7090
sample
Total time = 10 minutes
2005/08/01

APPENDIX E

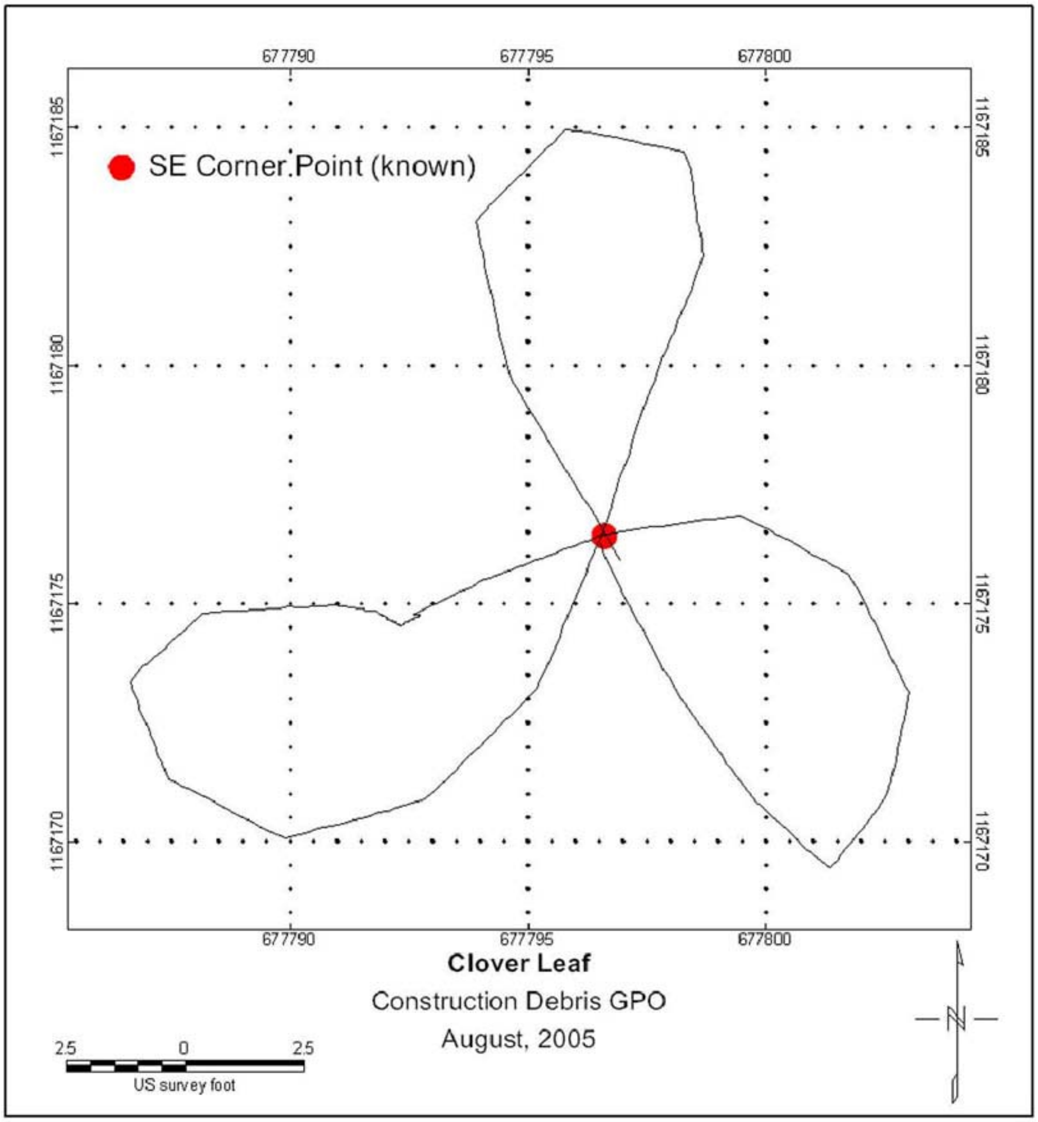
SIX LINE TEST

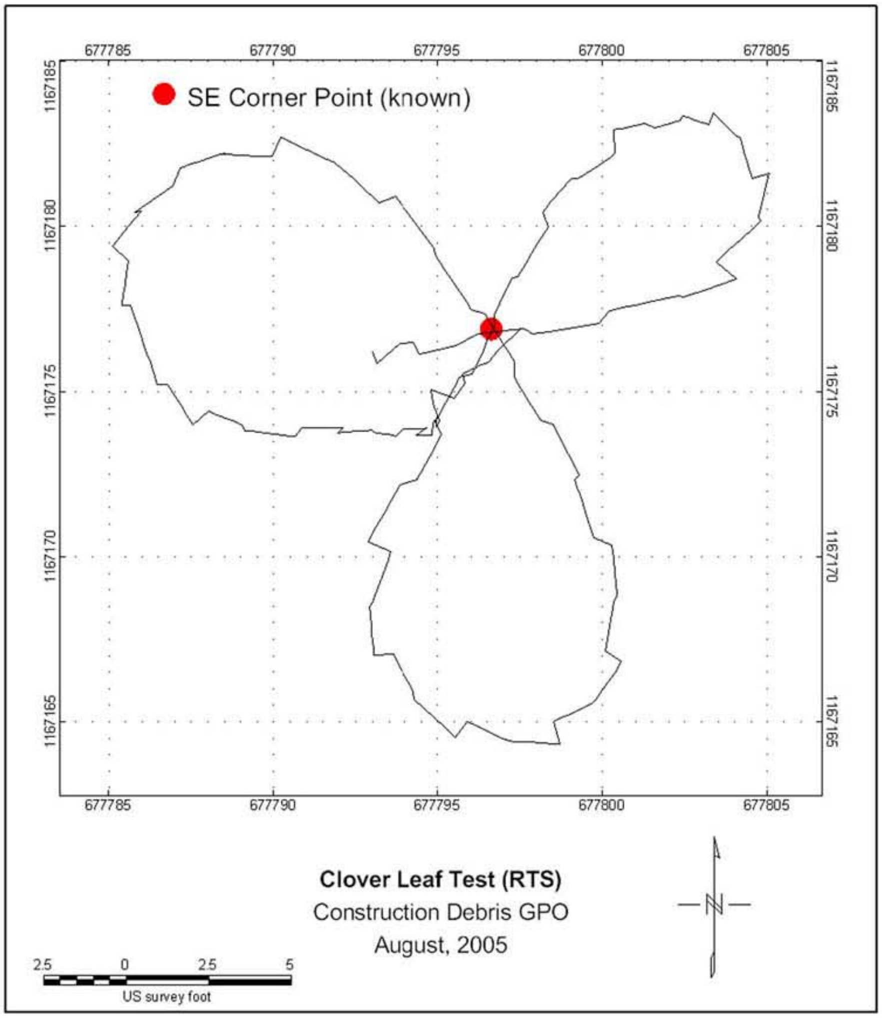

677790
677800
677810
677820
677830
1167210
1167200
1167190
1167180
1167170
1167160
known item
unknown in road
fast pace
normal pace
slow pace
Six Line Test
Construction Debris GPO
August, 2005
5 0 5 10 15
US survey foot


677790
677800
677810
677820
677830
1167210
1167200
1167190
1167180
1167170
1167160
known item
unknown in road
fast pace
normal pace
slow pace
Six Line Test (RTS)
Construction Debris GPO
August, 2005
5 0 5 10 15
US survey foot

APPENDIX F

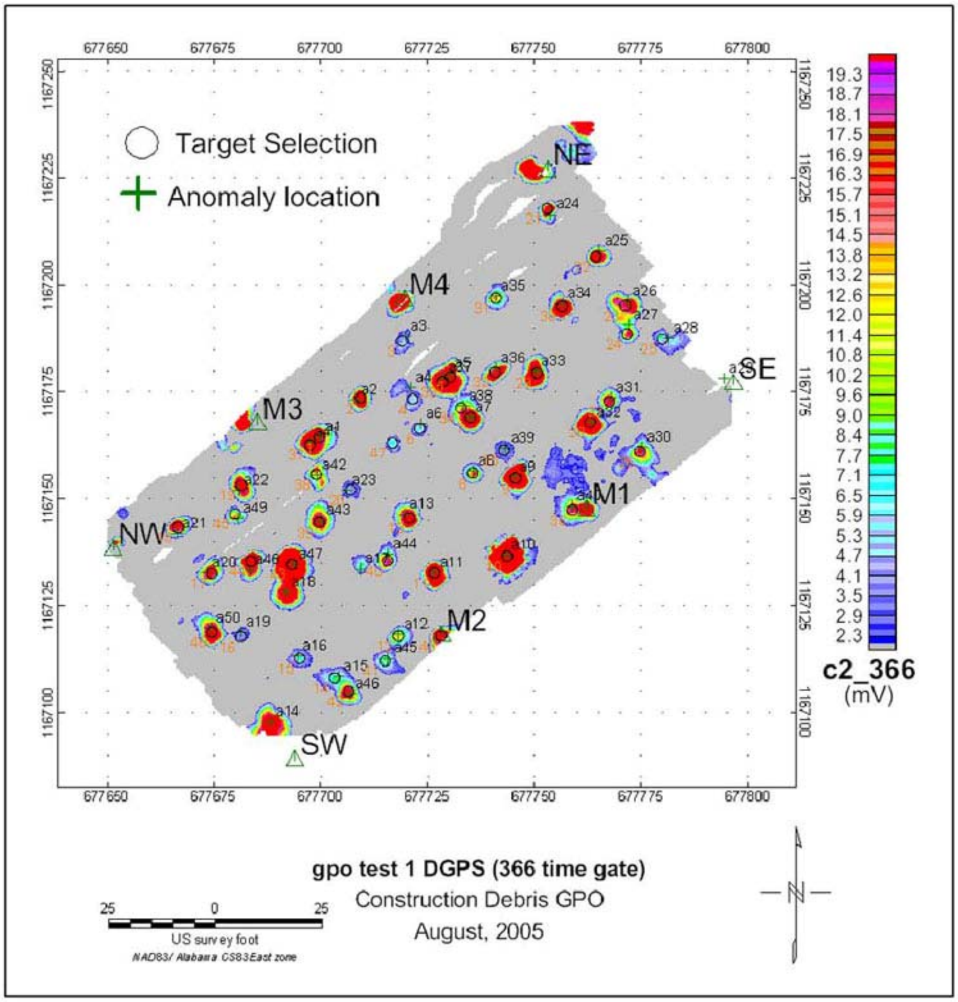
CLOVER LEAF

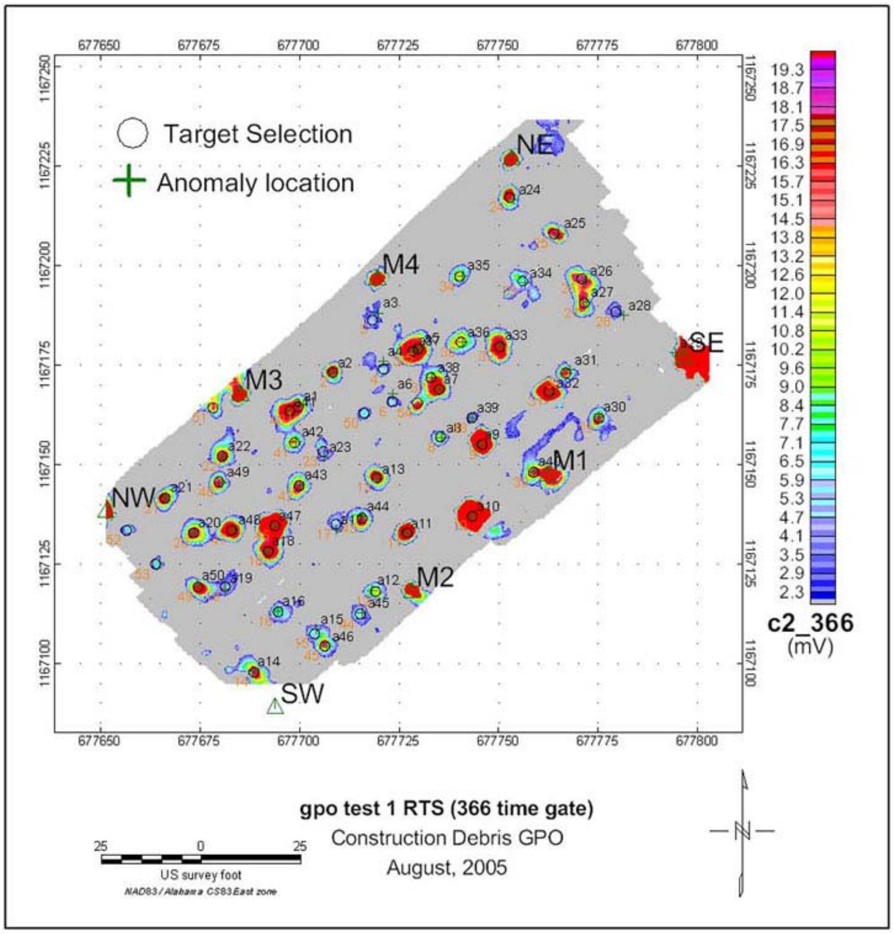

677790
677795
677800
1167185
1167180
1167175
1167170
SE Corner Point (known)
Clover Leaf
Construction Debris GPO
August, 2005
2.5
0
2.5
US survey foot
N

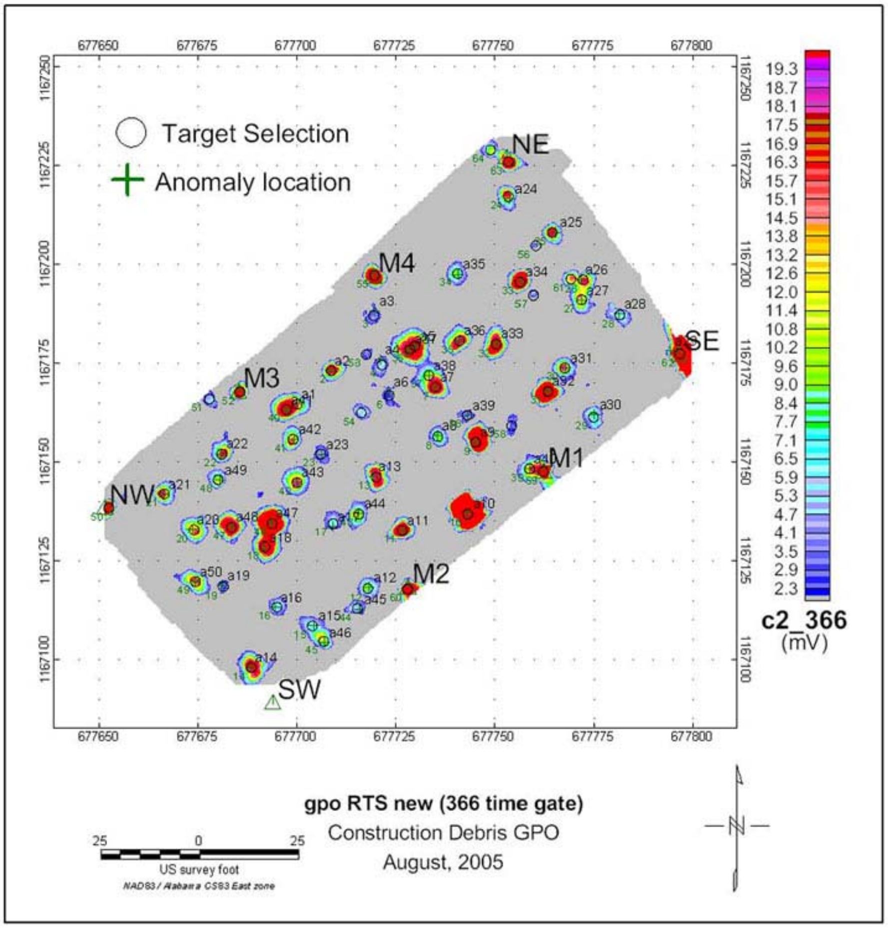

SE Corner Point (known)
677785
677790
677795
677800
677805
1167185
1167180
1167175
1167170
1167165
Clover Leaf Test (RTS)
Construction Debris GPO
August, 2005
2.5
0
2.5
5
US survey foot
N

APPENDIX G

DGPS AND RTS TEST


Target Selection
Anomaly location
NE
NW
SE
SW
M1
M2
M3
M4
c2_366
(mV)
gpo test 1 DGPS (366 time gate)
Construction Debris GPO
August, 2005
US survey foot
NAD83/ Alabama CS83East zone


Target Selection
Anomaly location
NE
M4
M3
M1
M2
NW
SE
SW
c2_366
(mV)
gpo test 1 RTS (366 time gate)
Construction Debris GPO
August, 2005
US survey foot
NAD83 / Alabama CS83 East zone


Target Selection
Anomaly location
NE
SE
NW
SW
M1
M2
M3
M4
c2_366
(mV)
gpo RTS new (366 time gate)
Construction Debris GPO
August, 2005
US survey foot
NAD83 / Alabama CS83 East zone